BIOLOGICAL EVALUATION OF THE GYPSY MOTH INFESTATION ON THE NORTHERN SECTION OF SHENANDOAH NATIONAL PARK, VIRGINIA

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ABSTRACT

Egg mass surveys on the Northern Section of Shenandoah National Park during January and February 1984 indicate that the gypsy moth (Lymantria dispar L.) has become established in this area. Egg masses were found in and around Mathews Arm Campground and in undeveloped areas along the Skyline Drive and Appalachian Trail north of the campground. Currently, the gypsy moth population is at a low level.

INTRODUCTION

Shenandoah National Park covers 195,000 acres, extending from Front Royal to just southeast of Waynesboro, Virginia. The park is well known for it's abundant wildlife, vast natural areas, and beautiful fall color best seen from the Skyline Drive. The drive runs along the Blue Ridge Mountain which forms the backbone of the park. The many miles of trails serve as a haven for day hikers and backpackers as they wind through back country and developed areas. The Appalachian Trail runs the entire length of the park on it's trek from Maine to Georgia.

Suspect gypsy moth egg masses were first observed by National Park Service personnel in Mathews Arm Campground. Their suspicions were confirmed by Mr. Tim Tigner of the Virginia Division of Forestry. During February, egg mass surveys were conducted by personnel from the National Park Service, Virginia Division of Forestry, Virginia Department of Agriculture and Consumer Services (VDACS), USDA Animal and Plant Health Inspection Service (APHIS) and USDA Forest Service. The confirmation of the egg masses in Mathews Arm is of concern to the federal and state regulatory agencies because this site lies south of the gypsy moth regulated area (Fig. 1). The involvement of Forest Pest Management stems from the Cooperative Agreement between the United States Departments of the Interior and Agriculture by which the Forest Service will "conduct detection surveys and biological evaluations of insect and disease outbreaks on forest lands administered by the Department of the Interior".

METHODS

For the past two trapping seasons, Forest Pest Management has facilitated the placement of gypsy moth pheromone traps on the Shenandoah National Park. These traps were placed by NPS personnel in campgrounds, picnic areas, scenic overlooks, and other areas where artificial introduction of some gypsy moth life stage was possible. The traps were serviced at least twice during the trapping season and the final trap catch information reported to Forest Pest Management.

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As a supplement to the 1982 trapping effort, egg mass searches by Forest Pest Management entomologists were conducted during the week of November 7, 1982. All trap sites where multiple trap catches had occurred were searched. Past experience has shown that it is extremely difficult to find egg masses in low level populations and that the ones that are found are usually well hidden. For these reasons our searches were very intensive. The visually exposed surfaces of the trees in and close to the trap location were scanned for egg masses by eye and with the aid of binoculars. In addition, rocks, leaf litter, material on the ground, and cavities in the trees were searched.

In 1983 a similar approach was taken for the trapping season.

However, there were three egg mass search and survey techniques used during this biological evaluation in February, 1984.

(1) Intensive searches (as described above).

(2) Five minute walks - Two observers (or one observer walking for 10 minutes) walk unrestricted through an area and count all new egg masses observed for five minutes. The observers never stop and do not look back. Their counts are totalled then divided by two. This average (X) is then used in the formula $Y = 20.56(X) + 14.58$ where Y = egg masses per acre.

(3) 1/40 acre fixed radius plot -

Plots are selected randomly and established by marking off a circular area around the plot center with an 18.6' radius. All egg masses on overstory vegetation seen with the aided or unaided eye are recorded. Understory vegetation is observed in the same manner and finally, objects on the ground are carefully examined. The total number of new egg masses observed are multiplied by 40 to arrive at an estimate of the number of egg masses per acre.

All three techniques were used in and around Mathews Arm Campground. The intensive search technique was used at ½ mile intervals along the skyline Drive from Elk Wallow Picnic Area to the part entrance at Front Royal and also along selected trails, fire roads, and ridge tops. When egg masses were found using this technique, a 1/40 acre plot was then established. This resulted in a biased survey. However, in evaluating the gypsy moth population, it was necessary to: (1) find areas of infestation. (2) estimate the highest population in these areas to determine the expected impact during 1984.

RESULTS

During the 1982 season 483 male gypsy moths were caught in 82 of the 100 pheromone traps placed in the park. The heaviest trap catches occurred in Page and Warren Counties (Table 1). Following the trapping season, intensive egg mass searches were conducted in the attempt to find additional gypsy moth life stages. Our searches were negative. No gypsy moth egg masses or evidence of additional life stages (cast larval skins, pupal cases) were found.

Results of the 1983 trapping effort on Shenandoah National Park show a significant increase in the number of male moths caught. In all, 1403 males were caught in 54 of the 76 traps placed (Table 2). As in 1982, the northern counties showed the highest trap catches. Table 3 shows a comparison of trap catches in the same locations for 1982 and 1983.

Prior to a planned egg mass search by Forest Pest Management, the discovery and confirmation of the six egg masses showed the presence of gypsy moth in Mathews Arm Campground. An area of approximately 5200 acres in and around the campground was initially surveyed using the five minute walk technique. Within this area, 175 sites were surveyed using 2 five minute walks. There were 24 positive sites and a total of 48 egg masses found. This data has been expanded in Table 4 to estimate the number of egg masses per acre. In addition to the five minute walk surveys, fifteen 1/40 acre plots were placed in and adjacent to the campground. The results of this sampling and expansion of the data to a per acre estimate are shown in Table 5. The heaviest concentrations of egg masses were found on the west side of the campground and access road (fig. 2).

Twenty-nine additional egg masses were found along the Skyline Drive, the Appalachian Trail, Compton Gap Fire Road and secondary trails norht of Mathews Arm (Fig. 3). Eleven of these were found by NPS personnel scattered along a .75 mile section of the Compton Gap Fire Road. These egg masses were singular. The remaining eighteen egg masses were found during an intense survey followed by establishment of 1/40 acre plots (Table 6).

DISCUSSION

Initially, the discovery and confirmation of gypsy moth egg masses in Mathews Arm Campground seems to indicate an artificial introduction. However, based on the increased trap catches at sites further north and south on the park, the discovery of egg masses in remote and inaccessible areas north of the campground (in the park and north of the park) and the proximity of the park (lying on the same ridge although some distance south) to known high populations of gypsy moth, it can be hypothesized that the infestations occurring on the Northern Section of Shenandoah National Park are part of the general gypsy moth infestation. While some degree of artificial introduction may have occurred in the campground, the spread of gypsy moth is not necessarily evenly distributed throughout a given area. Young caterpillars may be blown some distance from high populations to lightly infested or even uninfested areas. This phenomenon is very similar to the "spotting" that occurs in front of a forest fire and is dependent on wind directions and velocity. If the caterpillars land in acceptable host type, an infestation center may be established. Spread along ridge tops is also very common, partly because of predominance of favorable vegetation, but also because of the elevation and wind currents.

As a result of the egg mass survey findings, a recommendation by VDACS has been made to APHIS to include portions of Page and Rappahannock north of State Route 211 and east of State Route 675 in the regulated (quarantined) area. This is a reasonable administrative approach, since it is difficult to justify these infestations as isolated and caused entirely by accidental introduction.

Sampling of the gypsy moth population is needed to project the expected populations during the upcoming year and relate these projections to impacts on resource management objectives. So called "rule-of-thumb guidelines" (thresholds) have been developed for projecting survey data to expected defoliation. When egg mass densities on a per acre basis are estimated at 500 or above, heavy defoliation (>60% observable from the air) is likely. Densities of between 250 and 500 egg masses per acre indicate from light to moderate defoliation (30%-60%). The effects of single and multiple year defoliation on vegetation varies greatly among tree species, growing site, age and the presence of other stress factors (drought, other insect or disease activity). Coniferous species may die after one heavy defoliation. Deciduous species may withstand one or two defoliations but mortality increases greatly with subsequent defoliations. Growth and vigor are affected after one defoliation. Deciduous species under stress may die after one heavy defoliation.

Although gypsy moth is established on the Northern Section of Shenandoah National Park, the populations are at a low level. In the campground, when all the five minute walk data (175 sites) are used, the average egg mass density is 5 per acre. If only positive data (at least one egg mass observed during two 5 minute walks) are used the average density is 36 per acre. Both estimates are below the rule-of-thumb threshold for defoliation observable from the air. The 1/40 acre plot technique is considered more reliable. Using this data and considering all plots (positive and negative) the average egg mass density is 99 per acre. It should be noted that one plot in the campground was atypical with a total of 28 egg masses. Twenty two of these egg masses were found behind an area of dead bark and were not visible until the bark was removed. A much lower average egg mass density (24) would have resulted if this plot had not been considered. Using the data from either survey technique the results indicate that general heavy defoliation is unlikely in or around the campground during 1984. Moderate to heavy defoliation of individual trees could occur if multiple egg masses are present on those trees. This should not be widespread, however. The impact of gypsy moth feeding on the vegetation in the campground should be minimal for 1984. The trees are under stress already because of their site and the activities that occur around them. However, the additional stress of the gypsy moth feeding should not result in a general increase in tree mortality. When people and gypsy moth interact in recreation areas problems usually develop. Some individuals are allergic to the fine caterpillar hairs. Others find the dropping excrement very distasteful and a small percentage are entomophobic. These kinds of problems are common when high level gypsy moth populations occur in recreation areas. Because of the low level populations in Mathews Arm Campground these problems should be minimal.

The gypsy moth populations in the areas north of Mathews Arm Campground are also at low levels. In only one plot did the projected egg mass density approach the lower threshold (250 egg masses/acre) of observable defoliation. This plot was atypical in that five of the egg masses were extremely small in size and clumped on one tree. Impacts on vegetation, other resources and visitors in these areas will be minimal.

It is interesting to note that the majority of egg masses that could be closely observed showed signs of parasitism. Fewer egg masses showed signs of predation presumably by birds. The role of parasites and predators on the gypsy moth population in the park is presently unknown, but at least some degree of natural control is occurring.

The resource management objectives for the park should be met in 1984 in spite of the low level gypsy moth population present and with no suppression techniques employed. However, it is likely that populations will increase to defoliating levels and infestations will occur in developed and other sensitive areas in the future. At some point, suppression activities may be needed to meet resource management objectives. However, it may be possible using an integrated pest management strategy to extend this time frame. Alternatives which should be considered for use in areas with low level populations and where suppression is appropriate include:

(1) Application of biological or chemical insecticides.

(2) Release of parasite or predators to augment existing populations or establish new populations.

(3) Mass trapping of adult males.

(4) Use of the gypsy moth pheromone to disrupt mating.

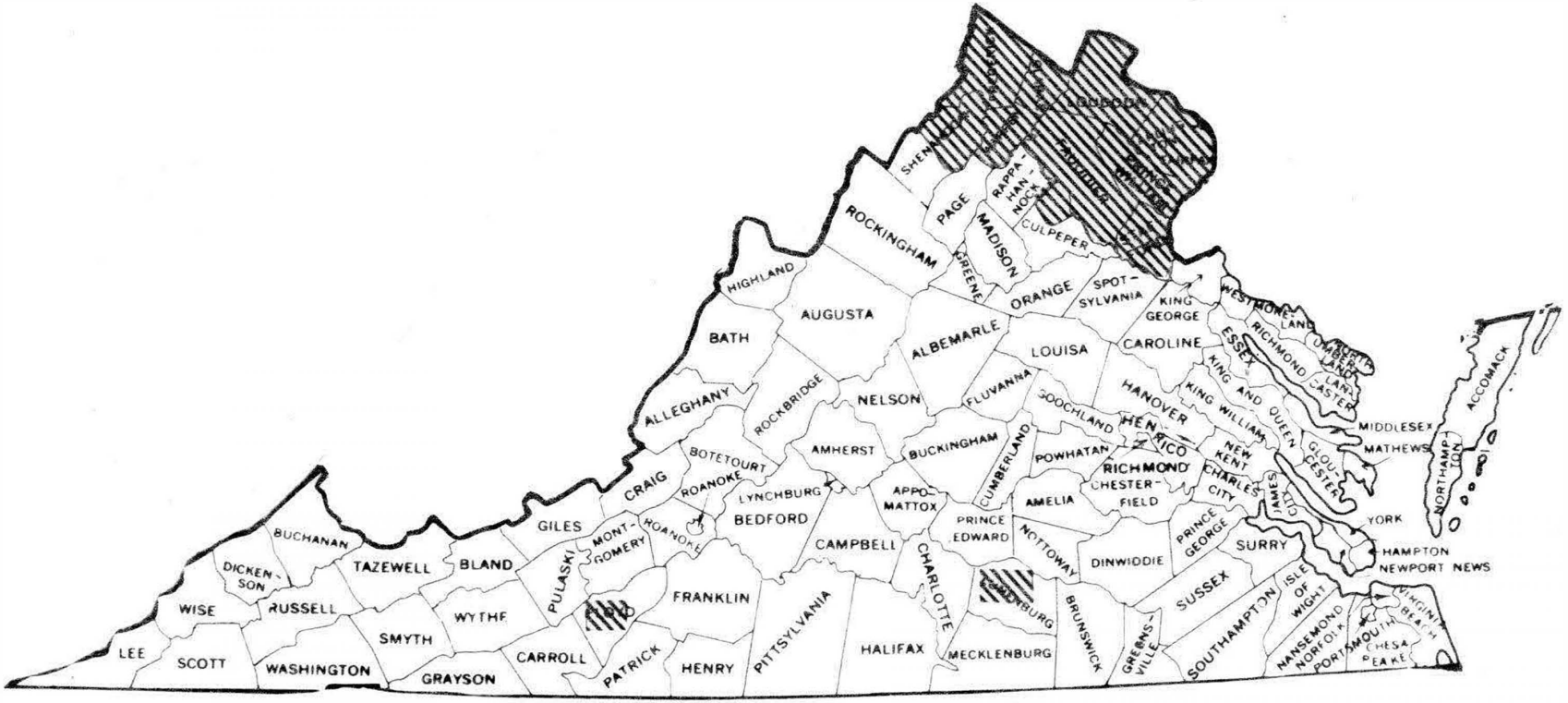
(5) Removal and destruction of gypsy moth caterpillars through larval trapping.

(6) Removal and destruction or treatment of egg masses.

By using one or a combination of these alternatives, low level populations may be discouraged from increasing.

The integrated approach to pest management also utilizes detection and evaluation as components of the overall program. Further pheromone trapping for adult males and burlap banding for larvae should be conducted during 1984. Forest Pest Management will supply the necessary materials. In addition, Forest Pest Management will continue to cooperate with the staff of Shenandoah National Park and the other agencies responsible for evaluating the gypsy moth infestation.

FIGURE 1.-- REGULATED AREAS FOR GYPSY MOTH IN VIRGINIA

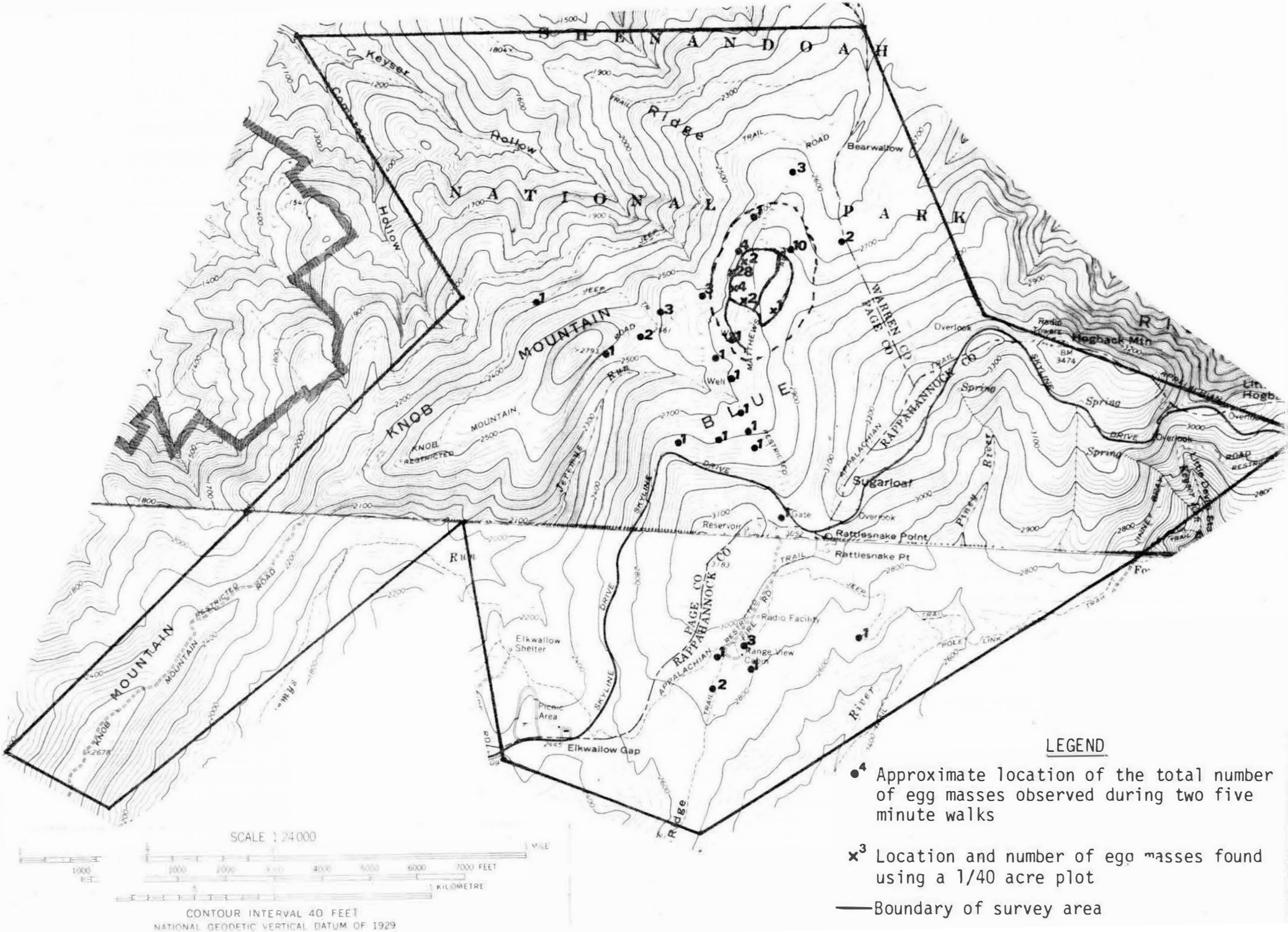


LEGEND

REGULATED AREAS

REGULATED AREAS IN FLOYD AND LUNENBURG COUNTIES NOT TO SCALE. AREAS ARE SMALLER THAN INDICATED

FIGURE 2.-- LOCATION OF GYPSY MOTH EGG MASSES IN AND AROUND MATHEWS ARM CAMPGROUND



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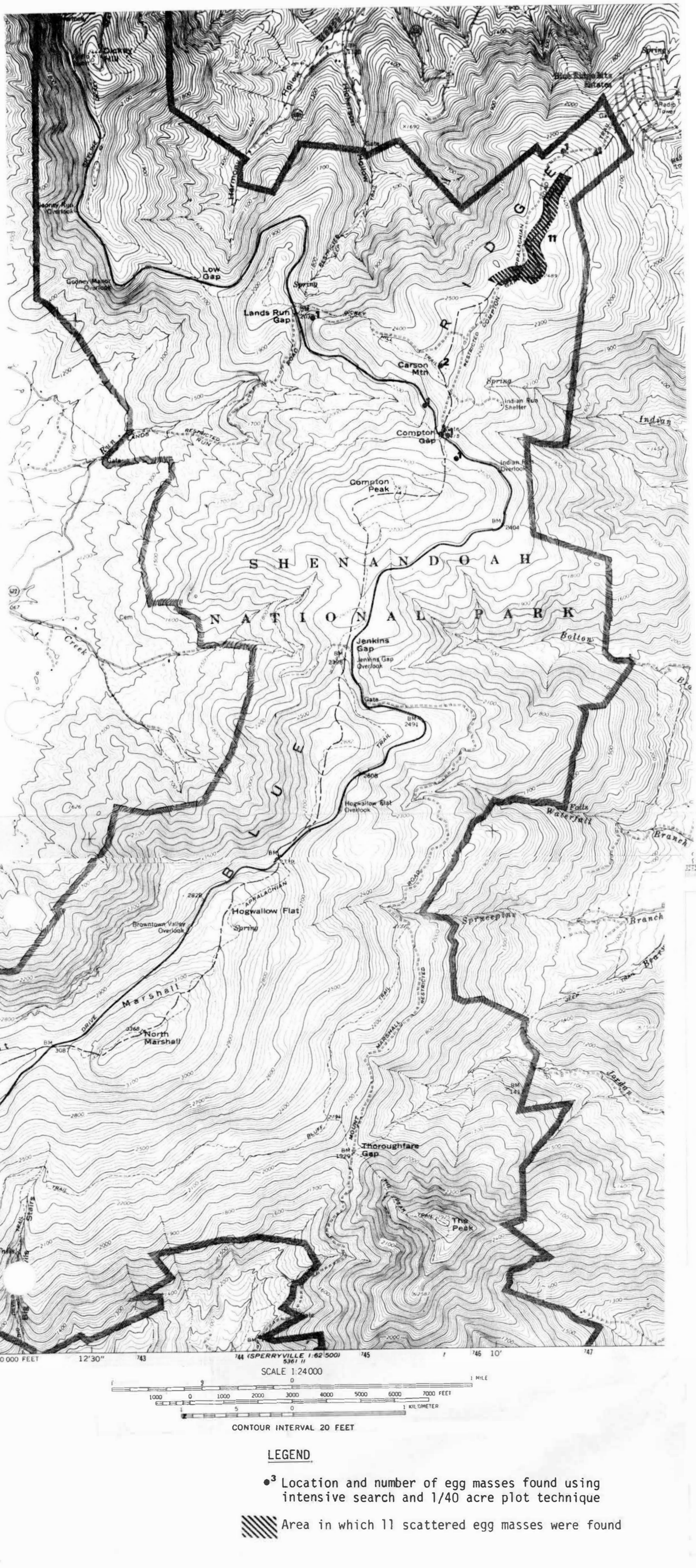
●[4] Approximate location of the total number of egg masses observed during two five minute walks

×[3] Location and number of egg masses found using a 1/40 acre plot

——Boundary of survey area

FIGURE 3.-- LOCATION AND NUMBER OF EGG MASSES FOUND IN AREAS NORTH OF MATHEWS ARM CAMPGROUND



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•[3] Location and number of egg masses found using intensive search and 1/40 acre plot technique

Area in which 11 scattered egg masses were found

TABLE 1 -- 1982 GYPSY MOTH PHEROMONE TRAPPING RESULTS
BY COUNTY FOR SHENANDOAH NATIONAL PARK.

County	Number of Traps Placed	Number of Positive Traps	Total Number of Male Moths
Albemarle	2	0	0
Augusta	6	4	5
Greene	4	2	2
Madison	18	16	84
Page	22	22	150
Rappahannock	6	6	47
Rockingham	28	18	37
Warren	14	14	158
TOTALS	100	82	483

TABLE 2 -- 1983 GYPSY MOTH PHEROMONE TRAPPING RESULTS
BY COUNTY FOR SHENANDOAH NATIONAL PARK

County	Number of Traps Placed	Number of Positive Traps	Total Number of Male Moths
Albemarle	12	2	3
Augusta	2	0	0
Greene	4	3	10
Madison	17	16	136
Page	23	17	677
Rappahannock	6	6	287
Rockingham	4	2	6
Warren	8	8	284
TOTALS	76	54	1403

TABLE 3 -- COMPARISON OF 1982 and 1983 TRAPPING RESULTS FOR SELECTED SITES AT SHENANDOAH NATIONAL PARK

Site	# Traps 1982	# Traps 1983	# Positive Traps 1982	# Positive Traps 1983	# Male Moths 1982	# Male Moths 1983
Front Royal Entrance Station	2	2	2	2	28	174
Dickey Ridge Visitor Center & Picnic Grounds	4	6	4	6*	44	110
Mathews Arm Campground	4	4	4**	4***	55	366
Elk Wallow Picnic Area	2	6	2	6****	17	287

* 3 traps disturbed during trapping season

** 1 trap disturbed during trapping season

*** 3 traps disturbed during trapping season

**** 4 traps disturbed during trapping season

TABLE 4 -- EXPANSION OF 5 MINUTE WALK COUNTS TO A PER ACRE BASIS FOR THE MATHEWS ARM CAMPGROUND AREA

Total Egg Masses Counted (2 - 5 min. walks)	# Sites with Same Results	$\bar{X}$/5 min. walk (X)	Estimated # Egg Masses/Acre $Y = 20.56 (X) + 14.58$
0	151	0	0
1	14	.5	25
2	3	1	36
3	4	1.5	46
4	2	2.0	56
10	1	5	118

TABLE 5 -- RESULTS OF 1/40 ACRE PLOT SAMPLING EXPANDED TO A PER ACRE BASIS FOR MATHEWS ARM CAMPGROUND AREA

#Egg Masses Observed(X)	#Plots With Same Results	Estimated Number of Egg Masses/Acre Y = 40(X)
0	10	0
1	1	40
2	2	80
4	1	160
28	1	1120

TABLE 6 -- RESULTS OF 1/40 ACRE PLOT SAMPLING EXPANDED TO A PER ACRE BASIS FOR AREAS NORTH OF MATHEWS ARM CAMPGROUND

# Egg Masses in Plot (X)	# Plots with the same Results	Estimated # Egg Masses/Acre Y = 40X
1	10	40
2	1	80
6	1	240

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